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MEDICAL GYMNASTICS IN LOCOMOTOR ATAXIA

THE FRENKEL AND OTHER EXERCISES *

By H. V. BARCLAY, M.D.

THE importance of training and regulated exercises has been understood since the earliest times, not only for the purpose of developing the body and bringing out its highest efficiency, but also as a means for restoring lost health. The history of gymnastics is very interesting. The honor of being the first to systematize exercises according to scientific principles in modern times belongs to the Swedish philosopher and poet Per Henrik Ling (1760-1840). With support of the Swedish government he founded, in 1813, The Royal Central Gymnastic Institute at Stockholm, an institution which ever since has been the principal seat of learning in the world for gymnastics, ordinary and therapeutic, including therapeutic massage. His system was introduced in this country about 45 years ago by the brothers, Drs. Robert and George Taylor, under the name of the Swedish Movement Cure, a name which on account of misuse and associations of doubtful character I regret to say, is no longer a fit name to use.

Important improvements and further developments have been made since the time of Ling, both in Sweden and elsewhere. Among them I may mention the Zander machine gymnastics, a system by which the Ling exercises are applied by means of machines, ingeniously constructed and delicately gauged. Zander Institutes are established in most large cities in Europe and America. The so-called Schott or Nauheim exercises are but an adaptation of the Ling exercises for chronic heart disease.

The Frenkel exercises, which we shall now consider, are of more recent date and form a decided advance in the treatment of tabes or locomotor ataxia. They are based upon the cognizance of the fact that the sensory nervous system plays a most important and essential part in the execution of the movements. Physiological experiments and researches have proven that the phenomena of sensation are not related merely to the skin, but to nearly all other organs, although somewhat different in kind and character. Now so far as the motor apparatus is concerned, we speak, for instance, of a muscular sense, by which we are able to determine the state of activity of a muscle; *i.e.*, the force, the speed and duration of contraction, which, furthermore, will enable us

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to know the state of any number of muscles working together in co-ordination, and still further, the place, position and condition of that portion of the body to which they are attached. By this muscular sense and the sensibility existing in joints, we are enabled, under normal conditions, to know the exact position of our limbs, or other parts of our body, even without the help of vision; it is absolutely necessary that we should know it, since it is impossible for the will to direct proper movements, where the knowledge of the exact whereabouts of the parts to be moved is wanting. Now, in the ataxic person, this is always more or less wanting; sometimes in so mild a degree that the patient himself may not be conscious of it; sometimes, however, to such an extent that the patient declares that he is in absolute ignorance of the whereabouts of his limbs when he does not see them. This explains many of the peculiarities of ataxic movements, and also points directly to the lesion in this disease which, as we know, is to be found in the posterior or sensory tract of the spinal cord and consists in a slow degenerative process causing sclerotic changes with consequent interference, pressure and destruction of the nerve fibre cells and centres. Only in advanced cases does this process extend to the anterior or motor tract of the cord.

In order to understand it better, let us recall a few of the parts concerned in the normal execution of movements. Generally speaking, the action is this: that while certain muscles perform the movement, other muscles act as supports; but both the moving and the supporting muscles are subject to continual changes; so that before a movement is completed new fibres and new muscles have successively come into play, while others, in similar succession, have ceased their action. This goes on so smoothly and with such accuracy, that under normal conditions it is impossible to tell where one ceases and the other begins. This harmonious and orderly action in the execution of movements is what we understand by co-ordination.

In locomotor ataxia the case is quite different. Here the movements are apt to be interrupted, and attended with short stops. The patient may thus, in stretching out the legs, do it in three or more sectional pushes. The same will be observed in other movements, particularly in ab- and adduction of the bent knees in the lying position. It is due to the lack of muscular and joint sensibility above referred to. When one set of muscles is through with its part of the movement, the patient is not conscious of it; further action ceases; the limb is not moved; the action of gravity breaks it out of its course before the impeded sensibility finally brings it to his notice, when he tries to correct it and proceed with the motion.

A peculiarity, observed particularly in the first stages of the disease,

the so-called pre-ataxic state, is a certain stiffness or tension of the muscles above the joints, increased when the patient attempts to stand or walk with eyes closed. This phenomenon is instinctive, but at the same time quite voluntary of origin, and the reasons for it are: first, that it adds to his security of motion; second, that the strain of his tendons enables him to feel better the position of his limbs and joints,—a condition, however, which naturally taxes the patient's strength greatly on account of the extra power that he is compelled to exert.

We observe a tendency in ataxic persons to perform quick movements. When they walk, they throw their legs out quickly and to the side. This is because they instinctively try by quickness of motion and by keeping the legs apart to overcome their unsteadiness. Another peculiarity is the suddenness and the quickness with which they fall. Apparently they fall without the slightest notice. The explanation is easy, however, when we remember how difficult it is for them to know and to keep control of the exact position of their knees, and thus when it happens that these become flexed, ever so little, unguardedly, down they go before they have time to recover and restrain the downward movement, having the force or power to prevent this, when used in time. To guard against this accident, we find that tabetic patients keep their knees hyper-extended. But examining more closely, we observe that this hyper-extension is often of an abnormally large degree, *i.e.*, more than is possible for any person normally.

Here we come to still another peculiarity, always present in greater or lesser degree in locomotor ataxia; *viz.*: hypotonia,—a strange, loose, or lax condition of one or more joints. Hypotonia is due to a partial or total loss of the natural tension existing normally in all muscles, and which we know serves to steady and support the joints, both when in use and when not in use, and is not due as has been supposed to relaxed ligaments or joint capsules, which, however, may suffer secondarily. In the knee it occurs chiefly as hyper-extension, due to slacking of the flexor muscles, but may occur in both flexors and extensors of any joint, even in the back, often making it possible for these patients to perform unusual feats; for instance, lying on the back, they can, with the greatest ease, raise their legs with straight knees, upwards and backwards much farther than normally, even so that their toes may touch the pillow upon which the head rests. Hypotonia is not a condition which produces ataxic movements *per se*, but causing the joint and thereby the body to deviate from the normal position, it throws it out of its balance and adds greatly to the difficulty of maintaining certain positions and in the execution of movements, the extraordinary excursions and deviations of which are further increased and made even more irregular.

The man who has recently gained much prominence, and deservedly so, in regard to the gymnastic treatment, is Dr. H. S. Frenkel, of Heyden, Switzerland, above referred to, whose new system of compensatory training therapy, has achieved important results.

To call this method a new system is not entirely correct, since his exercises in principle do not differ from ordinary gymnastic exercises prescribed for such conditions, but they rest on a true understanding of the motor problems of this disease, and the pathology behind them, so are especially formulated to meet the great motor difficulty, viz.: the deficiency of co-ordination which, as we have heard, is due to loss of muscle and joint sensibility, and appears as loss of balance and inability to properly direct movements of the affected parts. The aim of the exercises is therefore to train the patient in directing his movements, to properly show him how to obtain and maintain his balance, and have him go on with the exercises until as nearly as possible he re-acquires the correct habit of executing them, on account of which they are also spoken of as re-educational training movements.

This is the great achievement of Dr. Frenkel, through which a most valuable complement has been added to the system of general medical gymnastics.

As to the possibility of re-establishing function in the pathologically-changed parts, *i.e.*, the posterior sensory tracts, we know very little. It does not seem possible, at least where great or total destruction of nerve tissue has taken place; but the Frenkel method of training which is symptomatic in character, does not concern itself much in speculation on this point. He reasons like this: the chief property of nerve substance is its power to receive impressions from the outer world, to retain them, and store them up, so to speak, and to be able to make use of them in the future, when required. This is accomplished first, by giving strict attention to the matter, be it of a physical or mental kind; secondly, by having it repeated the requisite number of times until acquired or learned. Now, this is what we ordinarily term "learning" or "education," and when employed in reference to body movements, it seems that, in order to obtain a certain movement, we must study it, and try to do it; then repeat it until learned, when it becomes our property. In support of this theory of training exercises, Dr. Frenkel says that this is really the way all co-ordinated movements are originally learned. At birth a child's movements are most irregular, but by repeated trials it finally learns to direct and master the movements of its limbs, learns to creep, to hold on, to walk, etc. By perseveringly trying a movement over and over again, we know also that most astounding feats can be learned; for example, the wonderful performances of

acrobats, the masterful use of the feet and toes where hands have been lost, the extreme fineness and delicacy of touch of the blind in compensation of lost sight—all showing the possibility of increased perfection and utility of other faculties in compensation of those lost.

Now this property or power of the nervous system of learning or training ourselves up to something, is what we make use of in the treatment of locomotor ataxia. We start in to train the patient, we teach him to perform movements that he has lost, beginning with simple and easy ones, going from them, when learned, to more difficult ones, and thus by degrees re-establish what he has lost as far as possible. (A method not different in principle to that of ordinary school gymnastics.) In this way, by making better use of what sensory fibres he has left (and there is no case where all forms of sensation are lost), he will by degrees learn more and more, better and better.

In the beginning, and in severer cases, always, the patient will be obliged to make good use of his sight, as this is his easiest compensatory means, and in bad cases his chief one.

To begin with, let me give a few simple general rules for the performances of the exercises. They must be executed with the greatest accuracy and precision possible, especially trying to avoid any stops or interruptions until the movement is completed. The movements are to be repeated daily until learned. Quickness of motion, to which there is a strong tendency must not be allowed until in the later stages of the treatment, when slow motions are well mastered, and speed comes into consideration as part of the treatment. The exercises must never be prolonged or repeated so often as to tire out the patient, and it is imperative at all times, particularly in the erect position, that he be well guarded from falls and injury.

Now for the exercises themselves. In a brief paper like this, obviously I cannot go much into detail, and it would also be uninteresting to most of my readers. The exercises, so far as the lower extremities are concerned, are performed either lying down, sitting, or in the erect position.

The lying-down exercises are the easiest to perform, because the weight of the body and its balance are eliminated; even the weight of the legs may be eliminated by holding the legs suspended by the hands of the attendant or by straps from a suitable apparatus. At first they consist of the simplest forms of movements, such as bending and stretching of the leg, to make it easier, the heel at first being allowed to rest upon the bed, later without touching it. The patient is then made to try more difficult ones; for instance, passing the heel of one leg along

the edge of the tibia of the other, at first touching it with the heel; later without; then he is told to practice placing his heel at certain designated points, for example, on the knee, then on the middle of the tibia, then on the toes of the other leg, to do which later he will have to bend the knee of his leg a little; similarly he may be told to place it under his other knee, at some place on the bed, in the physician's hand held at different places and heights, and so on; likewise he may use his toes for touching, instead of the heel. Ab- and adduction are also practiced in the lying position, either with straight or bent knees; in the latter position, interruption of movements is apt to occur. As the patient improves, more difficult movements and combinations of movements are tried; for example, bending one leg while the other is stretched out, keeping one leg bent while the other is being ab- and adducted, drawing both legs up while trying to hold a handkerchief between the feet; in this latter movement the sense of touch is brought strongly into play. Until now the patient has been supposed to see the movement of his legs. At the proper time he will require to try the movements without keeping his eyes on the legs.

The sitting position is not so well adapted for exercises as the lying and standing, on account of the limited excursions of the legs possible. The exercises will be similar to those in the lying position, besides which the patient has the opportunity to make his feet familiar with touching the floor, for the furtherance of which he is told to practice putting his feet down with some force. In the sitting position the ataxia of the adductors is well observed, as the tendency is for the patient's knees to fall aside so as to cause the feet to rest almost on their outer edges.

One of the hardest problems for the tabetic patient is to stand up from the sitting position, and to learn this well will require prolonged and careful practice. His tendency is to go backwards when he makes the attempt to stand up; he prefers to have the back of his legs touch or lean against the chair or bench from which he arises, so as to get some support from it and be sure to have it right back and under him in case he should fall,—what he always fears,—and lastly because the touch of the chair enables him to know the position of his knees better. But this is the poorest way he can select to get up; the principle of the movement must be explained to him; he must be told that in order to rise slowly, the point of gravity of his body must be directly over his feet, and to accomplish this he is told, first, to move his feet a little back and under him, then he must bend his body well forward, and then raise himself a little from the chair. In this manner he will have the point of gravity almost directly over his feet, even before he leaves the seat of

the chair, and with very little accommodation he finds his balance at this point, and not until then is he to straighten up. Patients usually understand and appreciate the correctness of this mode of performing the exercise; yet it may take them considerable time before they can actually master it.

The exercises in the standing position are, first, to train the patient to keep his balance in the main or fundamental standing position, with heels together, feet forming somewhat less than a right angle, keeping his body straight, shoulders a little back, chest expanded, and looking straight ahead, the arms hanging alongside the side of the thigh. In many patients a parallel position is the best on account of the strong tendency toward eversion of the feet. The different standing positions are practiced: one foot forward, sideways forward, sideways, sideways-backwards, backward, and even crossways, forward-and-backward; his attention is called to the fact that he must rest equally on both feet, a matter not easily accomplished, as one leg is usually affected more by the ataxia than the other and less to be depended upon; wherefore the natural tendency is to make use of the better one as much as possible. A constant over-use in this way of one leg and under-use of the other will cause the proportional strength and ability of co-ordination in the two legs to differ very much, and this is apt to increase rapidly. I need hardly mention that it is the weaker and most affected parts that will always receive the chief attention, with due care, however, to the amount of exercise they can endure without becoming tired. Next may be practiced the raising up on the toes, bending the knees, etc., in the different positions; the floor is often marked so that the patient can know exactly where he is wanted to place his foot. This is even more important when he comes to the walking exercises. Before these are attempted he is made to perform balancing exercises,—resting on one foot, taking a step forward or backward, and he is taught to shift the weight of his body with the motions from one leg over to the other; later he is made to take two or more steps, at first slowly. As an initial exercise, he may be made to walk sideways, as this is easier than forward, during which he must note carefully the way the body is balanced during the different phases of the movement. As he goes on improving he has to practice walking without looking at his feet, walking along a line, over obstacles placed in his way, with measured steps, etc., he is taught how to change his direction, walk backwards and so on. When he can walk slowly, it may be well to practice quicker and more rapid walking and marches; the patient should be drilled like a soldier. Where two or more patients are affected in about the same way, and are so much

improved that there is no danger from falls, they can very well be drilled together; otherwise it is better to exercise the one while the others rest and look on. As before mentioned, it is important that there should be plenty of intermissions for rest; the patient who rests will also learn from the instructions received and mistakes made by others. When ordinary marches are well performed, it is time to try toe marches and running marches, even jumping, walking up and down steps and staircases. While doing marches, let them hold their hands in different positions, give them things to carry in their hands, on their backs, even on their heads.

Exercises of the upper extremities will have to be modified so as to conform to their natural movements and uses. The ordinary free exercises—arm raising, bendings, stretchings, in different directions and planes, circumduction, etc.—are indicated.

Exercises to place hands and fingers on designated spots are of first importance. This may be made more interesting by encouraging the patient to play games, where these things have to be practiced as part of the game; for example, chess and checkers. There is a great variety of schemes for such exercises; for example, placing pins in holes on a board, the piling up of coins or chips, exercises and plays with balls suspended from strings, etc. Ordinarily, free standing and other gymnastic exercises where the positions of the trunk and arms and legs are changed, are naturally very useful, and should be directed in accordance with the condition of the parts affected by the disease. They may, for example, be used with good effect in the training of the muscles around the hip-joint, which are commonly much at fault.

Different sorts of apparatus have been designed to facilitate the practice of training exercises. I will only mention a few of the best; for example, parallel bars placed at the height of the hip-joint, and resembling the gang-plank of a steamer; sometimes they are placed in the shape of a cross. The patient will here be able to steady himself by the hands, the point being, however, to touch or hold on to the bars as lightly as possible, and to practice exercises alone, depending for his support upon himself solely, which otherwise may be impossible. It likewise gives his hands good training. This is, however, only an intermediate stage of training, and should be given up when no longer necessary. For bad cases, even those in the so-called paralytic stage, a broad belt to fasten around the waist is often used; it is supplied with handles for the attendant to take hold of, making it possible to practice walking exercises with security.

Besides the exercises described, I make use of resisted exercises to

a certain extent. I find that patients perform them uniformly better than the unresisted, the resistance adding to their conscious knowledge of their limbs.

Bearing in mind the free anastomoses of the circulation of the spinal cord and its surroundings, with the vertebræ, and the muscles of the back, I believe in the efficiency of massage and movements of the back and trunk, active as well as passive. They will serve to assist and to free blood and lymphatic circulation, relieve existing congestion, and cause any possible repair to take place. Massage of the limbs and abdomen is of benefit, and may be advantageously applied during intermissions of rest between the exercises.

In conclusion, I will say that the length of treatment, and the improvement to be expected, depend upon the stage of the disease, the courage of the patient, his aptitude for learning and the work he puts into it. It will always have to extend during a number of weeks, even months. Two short treatments daily are better than one long one. The extent of inability to use the limbs does not always indicate a measure for the improvement to be expected. Dr. Frenkel reports one of his most brilliant results in a case thoroughly helpless. I myself have had similar experiences. The greatest importance in the treatment rests on patience and perseverance and the observation of precise execution of details; and a good result may be looked for with a knowledge that the progress of the disease has been arrested.

THE ISABEL HAMPTON ROBB MEMORIAL CLUB CLEVELAND, OHIO

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THOSE nurses and friends who were closely associated with Mrs. Robb during the last few years of her life will remember that she had planned and worked for some time for a club house for nurses in Cleveland. She had, shortly before her death, taken active steps toward interesting some Cleveland people in it. It was, therefore, quite the natural thing, after the first shock of her death, for her friends, in their desire to do honor to her, to wish to create a memorial which would carry out and embody her idea of a club house: a place which would be the central location for all nursing interests; a place for holding local meetings; a place for central registry; a reference library; Red Cross